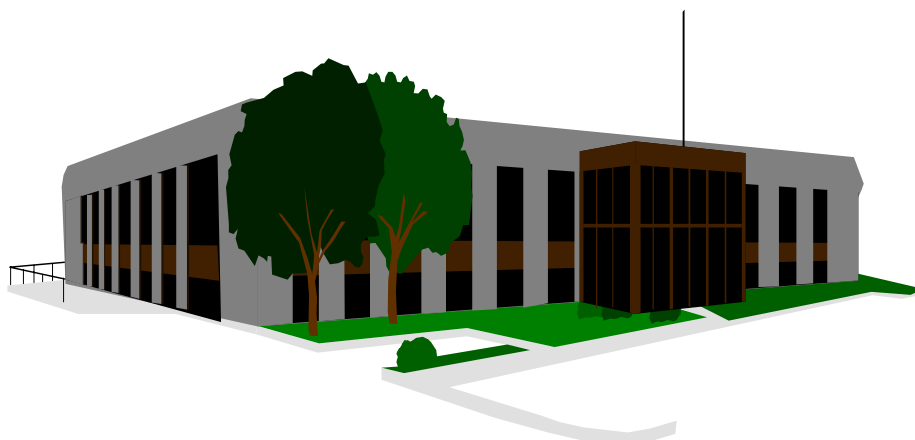


INDOOR AIR QUALITY REASSESSMENT

**Lynch Elementary School
19 Brantwood Road
Winchester, Massachusetts**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
July, 2001

Background/Introduction

At the request of Frank Rowe, Principal of Lynch Elementary School, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) conducted a reassessment of indoor air quality conditions at the Lynch Elementary School (LES), Winchester, MA. The school was originally visited on April 27, 2000, by Cory Holmes, Environmental Analyst, Emergency Response/Indoor Air Quality (ER/IAQ), BEHA. A report was issued (MDPH, 2000a) which described the conditions of the building at that time. The 2000 report showed that there were problems identified and gave recommendations on how to correct those problems. On March 14, 2001, a visit was made to this school by Michael Feeney, Chief of BEHA's ER/IAQ Program and Mr. Holmes to conduct a follow-up indoor air quality assessment.

Actions on Recommendations

BEHA previously made 26 short-term and 4 long-term recommendations (**in bold**) to improve indoor air quality at the school (MDPH, 2000a). School officials reported that they have acted on a number of these recommendations that are in control of school department personnel. The following is a status report of action(s) on BEHA recommendations based on reports from school officials, documents, photographs and BEHA staff observations.

Actions on Short-Term Recommendations:

1. **To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy independent of classroom thermostat control.**

In response to BEHA recommendations, the Winchester School Department hired a ventilation engineering firm to examine and repair classroom univents as well as balance the ventilation system. Univents in each of the 30 classrooms were reportedly calibrated, lubricated and readjusted. In addition, thermostats and pneumatic control devices were examined and replaced if found defective (Mechanical Air Control, Inc., 2001). The Mechanical Air Control report indicated that additional work on thermostats in some areas may be needed and that a protective maintenance program be implemented for both thermostatic controls and the HVAC system. BEHA staff found all univents and exhaust vents repaired and functioning.

2. **Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers school-wide.**

See response to action 1.

3. **Change filters for univents as per the manufacturer's instructions, or more frequently if needed. Clean and vacuum interior of univents prior to operation to avoid the re-aerosolization of accumulated dirt, dust and debris.**

School officials reported that filters are being changed in accordance with

manufacturer's recommendations. Units are also cleaned and vacuumed during each filter change.

4. **Restore exhaust ventilation in classrooms and office space. Examine rooftop exhaust motors for proper function; repair and replace parts as needed. Examine timer controlling exhaust system in classrooms 117-119 for proper function; repair and recalibrate if necessary.**

See response to action 1.

5. **Remove all blockages from univents and exhaust ventilators to ensure adequate airflow. Close classroom hallway doors to maximize exhaust ventilation.**

Staff were instructed via inter-school memorandum to remove materials obstructing airflow of univents and exhaust vents. In addition, placards were posted on univents to remind faculty to keep units free from clutter (see Picture 1). Adherence to this instruction was seen in most classrooms.

6. **Once both the fresh air supply and exhaust ventilation are functioning, the systems should be balanced by a ventilation engineer.**

See response to action 1

7. **Repair and/or replace thermostats and pneumatic controls as necessary to maintain control of thermal comfort. Consider contacting an HVAC engineer concerning the repair and calibration of thermostats and pneumatic controls school-wide.**

See response to action 1

8. **For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).**

School officials reported the implementation of “wet wiping” procedures to improve dust control and have reportedly included the purchase of HEPA filtered vacuum cleaners in their FY 02 budget.

9. **Ensure window mounted air conditioners are properly sealed to prevent water penetration and subsequent mold growth. Disinfect areas of water leaks with an appropriate antimicrobial as needed.**

Spaces around air conditioners were resealed. Building occupants reported to BEHA staff that no further leaks have occurred.

10. **Move plants away from univents and ensure drip pans are placed underneath plants in classrooms. Examine plants in classrooms for mold growth in water catch basins. Disinfect water catch basins with an appropriate antimicrobial if necessary.**

Staff were instructed to examine plants and drip pans for mold growth periodically and to remove from the air stream of univents. This advice was followed throughout the school.

11. **Examine carpeting for mold growth and remove/replace if moldy. Disinfect areas of floor underneath water-damaged carpeting with an appropriate antimicrobial.**

Carpeting in several areas was removed and replaced with floor tiles. School officials report that a program of carpet replacement has been instituted and is addressed in the school's operation & maintenance budget.

12. **Relocate or place tile or rubber matting underneath water coolers in carpeted areas.**

Rubber matting was placed under water coolers to prevent water damage to carpeting.

13. **Repair/replace broken windowpanes.**

The repair/replacement of windows and exterior doors school-wide has been raised at School Committee Meetings by Principal Row and the Lynch Tools for Schools Committee. A request for capital improvement to address this issue has been submitted to the Winchester School Department.

14. **Install weather-stripping around exterior doors to prevent water intrusion.**

See response to action 13.

15. **Inspect plant growth outside perimeter of building periodically; trim plants away from fresh air intakes as needed.**

Plants continue to be in direct contact with exterior walls (see Pictures 2 & 3) and is further addressed in the "Microbial/Moisture Concerns" section later in this report.

16. **Refrain from using the pottery kiln until equipment is provided with local exhaust ventilation independent of the general exhaust system.**

Ventilation for the kiln was reconfigured to provide local exhaust independent of the general exhaust (see Picture 4).

17. **Clean chalkboards and trays regularly to prevent the build-up of excessive chalk dust.**

Chalkboards were found free of excessive dust. Chalkboards are also slated to be replaced with dry erase boards over time.

18. **Encapsulate exposed pipe insulation to avoid the aerosolization of fiberglass fibers.**

A work order was reportedly submitted to the Winchester Department of Public Works (DPW) via the School Business Office by Lynch school staff for re-wrapping of exposed pipe insulation.

19. **Seal drains in art room or pour water down regularly to prevent sewer gas back up.**

The floor drain in the art room was sealed by school maintenance staff.

20. **Consider relocating photocopiers to a well-ventilated area or examine the feasibility of installing local exhaust ventilation.**

The school has included this issue to be addressed in their operating & maintenance budget.

21. **Consider reducing or discontinuing use of mimeograph machines.**

BEHA staff were informed that the use of mimeograph machines was limited to one individual on an infrequent basis.

22. **Have a complete inventory done in all storage areas and classrooms. Discard hazardous materials or empty containers of hazardous materials in a manner**

consistent with environmental statutes and regulations. Follow proper procedures for storing and securing hazardous materials. Obtain Material Safety Data Sheets (MSDS') for chemicals from manufacturers or suppliers. Be sure all materials are labeled clearly.

Staff have been informed by school officials to store flammable materials out of reach of students and to dispose of hazardous materials appropriately. More work is needed in this area; see "Other Concerns" section of this report.

23. **Change filters in window-mounted air conditioners as per the manufacturer's instructions to prevent the re-aerosolization of dirt, dust and particulate matter.**

School officials reported that filters are being maintained in accordance with air conditioner manufacturer's recommendations.

24. **Consider obtaining flameproof cabinets that meet NFPA requirements. Store flammable materials in the flameproof cabinets in a manner consistent with state and local fire codes.**

School officials report that flammable materials are being stored in accordance with local and state fire codes. *No flammable materials were noted to be improperly stored during the reassessment.*

25. **Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning of classrooms. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.**

School staff have been asked to reduce or eliminate piled items for easier classroom cleaning. Some areas need further attention in this area.

26. **Repair/replace loose/broken windowpanes and missing or damaged window caulking building-wide to prevent water penetration through window frames.**

See response to action 13.

Actions on Long-Term Recommendations:

1. **Consider consulting a building engineer, hydrogeologist and/or an environmental engineering firm about possible options to eliminate water penetration into the building. Consider removal of carpeting in areas prone to flooding.**

The Winchester DPW has installed new gutters and downspouts to the rear of the building which has had drainage problems. Carpeting was also removed and replaced with floor tiles in areas historically prone to water damage. School officials report that additional carpet replacement will reportedly be an on-going project and is addressed in the school's operation & maintenance budget.

2. **Inspect roof for proper drainage; consider consulting a building engineer about possible options to eliminate water pooling on roof.**

The issue of water pooling on the roof has been raised at School Committee Meetings by Principal Row and the Lynch Tools for Schools Committee. A request for capital improvement to address this issue has been submitted to the Winchester School Department.

3. **Repair cracks/spaces around foundation of the building to prevent moisture penetration and subsequent water damage. Consider sealing the cement slab/brick wall junction to prevent water penetration.**

Repair of cracks/spaces around foundation is currently in progress to eliminate water penetration into the building.

4. **Consider installing/restoring exhaust ventilation in the mailroom to help remove excess heat and odors generated by office and computer mainframe equipment.**

The school has reportedly included this issue to be addressed in their operation & maintenance budget.

Beyond the recommendations made in the initial report, the Lynch Tools for Schools committee has encouraged faculty and staff to take actions to improve their own air quality and has drafted informative fliers called Tips for Teachers (see Attachment I).

Methods

Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were taken with the TSI, Q-Trak IAQ Monitor, Model 8551.

Results

The school houses grades pre-kindergarten through fifth grade. It has a student population of approximately 400 and a staff of approximately 80. The tests were taken during normal operations at the school. Test results appear in Tables 1-5.

Discussion

Ventilation

Carbon dioxide levels were improved in a number of areas compared to the previous BEHA indoor air quality assessment. However in ten of thirty-five areas surveyed carbon dioxide levels were elevated above 800 parts per million, including the art room which is not equipped with mechanical ventilation. As mentioned in the previous BEHA report (MDPH, 2000a), carbon dioxide is used as a diagnostic tool to evaluate air exchange by building ventilation systems. Although several areas were considered to have elevated carbon dioxide levels, it is important to note that carbon dioxide itself has no acute (short-term) health effects associated with the measured levels at LES. To put this in perspective we have enclosed a copy of a letter describing carbon dioxide measurement and its role in addressing indoor air quality issues (MDPH, 2000b) see Attachment II.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is

impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature measurements ranged from 68° F to 73° F, which were close to the BEHA recommended comfort range for most areas. The BEHA recommends that indoor air temperatures be maintained in a range of 70° F to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. No temperature control complaints were expressed to BEHA staff during the reassessment.

The relative humidity measured in the building ranged from 27 to 32 percent, which was below the BEHA recommended comfort range. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

The school continues to experience problems with roof leakage. A number of areas still have water-stained ceiling panels, which are evidence of active or historic roof leaks. The BEHA reassessment occurred on a day following a period of heavy rain. A bucket was noted collecting water from an active leak in the hallway outside of classroom 112 (see Picture 5).

An inspection of the exterior of the school was conducted to identify possible sources of water entry. The building's roof drainage system collects water and directs it into a series of downspouts and/or drains. Along the front of the building holes were noted in the gutter system (see Picture 6), which can allow rainwater to pool on the ground at the base of the building against the exterior wall. The freezing and thawing action of water during the winter months can create cracks and fissures in the foundation. Over time, this process can undermine the integrity of the building envelope and provide a means of water entry into the building.

The courtyard walls of the school remain covered with ivy in a number of areas (see Picture 2). As discussed in the previous report, clinging plants can cause water damage to brickwork by inserting tendrils into brick and mortar. Water can penetrate into the brick along the tendrils, which can subsequently freeze and thaw during the winter. This freezing/thawing action can weaken bricks and mortar, resulting in damage to the wall. In order to avoid this problem, clinging plants on brickwork is not recommended.

Along the perimeter of the building, shrubbery and flowering plants were noted in close proximity to univent fresh air intakes (see Picture 3). The March 15th visit occurred after a period of heavy snowfall. Along the perimeter of the building, univent fresh air intakes were noted partially covered with snow (see Picture 7). Care should be taken to ensure that fresh air intakes remain clear of obstructions (e.g., snow, and shrubbery) to avoid the entrainment of dirt, moisture and/or pollen.

Other Concerns

Several other conditions were noted during the assessment, which can affect indoor air quality. The building reportedly has a problem with pest infestation. Black ants were observed by BEHA staff in the storeroom between classrooms 100 and 110. A number of conditions were noted that can attract pests including the storage of foodstuffs, crumbs/food debris on the floor and in the oven (see Pictures 8-10). A spray can of insecticide was also noted in this area on top of the refrigerator (see Picture 11). Applicators of this product should be in full compliance with federal and state rules and regulations that govern pesticide use including posting and notification requirements (333

CMR 13.10). Under no circumstances should untrained personnel apply this material. This product should not be applied prior to or during school hours. If application must be done during the school week, this material should be applied shortly after the school day ends, in order to give the applied areas ample time to dry. Under current Massachusetts law that will go into effect November 1, 2001, the principles of integrated pest management (IPM) must be used to remove pests in state buildings (Mass Act, 2000). A copy of the IPM guide is attached as Attachment III. Unlabeled/poorly labeled spray bottles were also noted. Products should be kept in their original containers, or should be clearly labeled as to their contents, for identification purposes in the event of an emergency.

Rodent/pest infestation can result in indoor air quality related symptoms due to materials in their wastes. Mouse urine contains a protein that is a known sensitizer (US EPA, 1992). A sensitizer is a material that can produce symptoms readily in sensitive individuals. Insect parts can become dried out and aerosolized and may serve as a source of allergenic material for certain sensitive individuals.

A three-step approach is necessary to eliminate rodent/pest infestation:

1. removal of the rodents/pests;
2. cleaning of waste products from the interior of the building; and
3. reduction/elimination of pathways/food sources that are attracting rodents/pests.

Occupants located in the basement/ground floor of the building complained of musty odors emanating from the crawlspace. BEHA staff noted spaces around the door

to this area (see Picture 12) that can serve as a means of egress for odors and drafts into occupied areas.

Conclusions/Recommendations

The actions taken on BEHA's previous recommendations by the Lynch Elementary School Tools for Schools Committee and school personnel working in conjunction with Winchester School Department and DPW have improved overall indoor air quality at the school. In view of the findings at the time of the visit, in addition to those made in the previous report, the following recommendations are made to further improve indoor air quality:

- 1) Examine the feasibility of providing mechanical ventilation to the art room (formerly the kitchen area).
- 2) Continue with plans to replace carpeting with tiles throughout the school.
- 3) Increase/improve carpet cleaning and dust control in classrooms. Continue with plans to obtain a HEPA filtered vacuum cleaner.
- 4) Consider the implementation of a comprehensive protective maintenance program for both thermostatic controls and the HVAC system.
- 5) Inspect shrubbery along outside perimeter of building periodically; trim away from fresh air intakes as needed. Clear snow drifts from univent fresh air intakes during periods of heavy snowfall.
- 6) It is highly recommended that the principles of integrated pest management (IPM) be used to rid this building of pests. A copy of the IPM recommendations are

included with this report as [Attachment III](#) (MDFA, 1996). Activities that can be used to eliminate pest infestation may include the following:

- a) Rinse out recycled food containers. Seal recycled containers with a tight fitting lid to prevent rodent access.
 - b) Remove non-food items that rodents are consuming.
 - c) Store foods in tight fitting containers.
 - d) Avoid eating in classrooms. In areas where food is consumed, periodic vacuuming to remove crumbs is recommended.
 - e) Regularly clean crumbs and other food residues from toasters, toaster ovens, microwave ovens and other food preparation equipment.
 - f) Holes as small as ¼” is enough space for rodents to enter an area. Examine each room and the exterior walls of the building for means of rodent egress and seal. If doors do not seal at the bottom, install a weather strip as a barrier.
 - g) Reduce harborages (cardboard boxes) where rodents may reside.
- 7) Store chemicals (pesticides) and cleaning products properly and out of the reach of students.

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Picture 1



Placard on Classroom Univent

Picture 2



Vine Growth on Exterior Walls of Courtyard

Picture 3



Plant Growth near Univent Fresh Air Intake

Picture 4



Reconfigured Local Exhaust for Kiln

Picture 5



**Active Roof Leak in Hallway outside of Classroom 112
Note Bucket beneath Leak to Catch Water**

Picture 6



Water Leakage (Indicated by Arrows) through Holes in Gutter System

Picture 7



Univent Fresh Air Intake Obstructed with Snow, Also Note Vehicle Backed-into Parking Spot

Picture 8



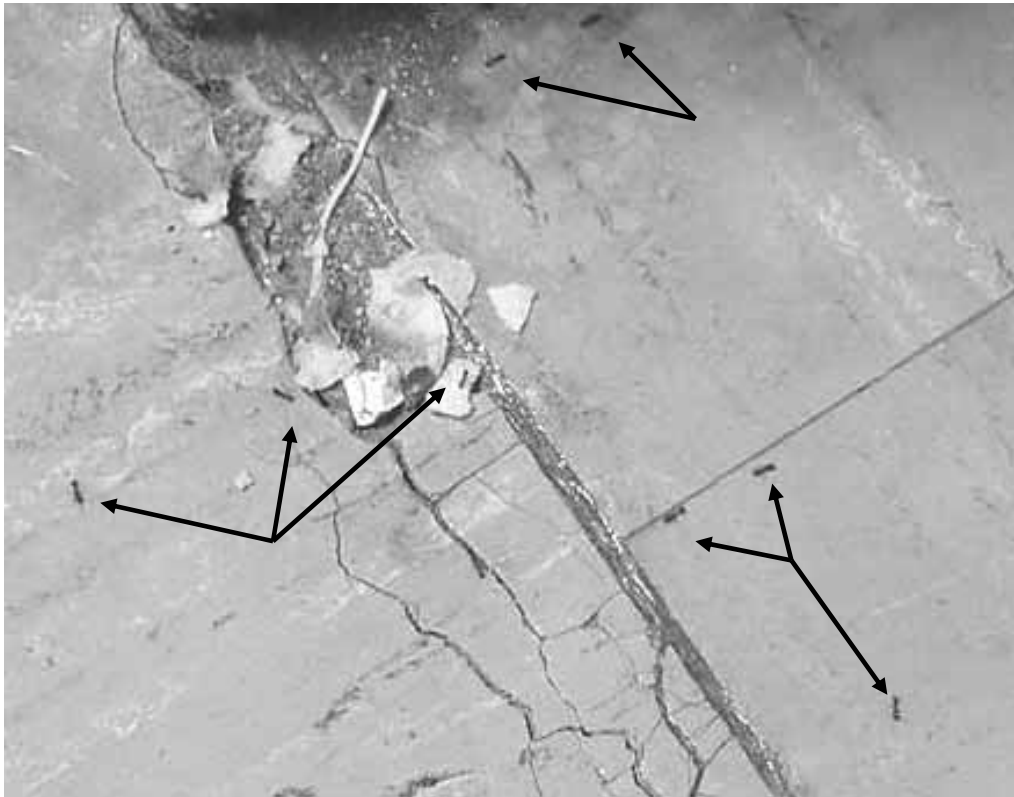
Foodstuffs Stored between Classrooms 100 & 110

Picture 9



Food Debris/Crumbs in Oven between Classrooms 100 & 110

Picture 10



**Food Debris/Crumbs on Floor between Classrooms 100 & 110
Note Black Ants Indicated by Arrows**

Picture 11



Insecticide on top of Refrigerator in Storeroom between Classrooms 100 & 110

Picture 12



Crawlspace Door

TABLE 1

Indoor Air Test Results –Lynch Elementary School, Winchester, MA – March 15, 2001

Remarks	Carbon Dioxide *ppm (CO ₂)	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	403	43	50					weather conditions: overcast, light breeze
Art Room	945	70	30	19	yes	no	no	floor drain-capped, broken window
Gym	759	70	30	0	Yes	yes	yes	
Main Office	877	72	29	4	Yes	No	No	Window mounted a/c
Classroom 101	700	72	32	20	yes	yes	yes	
Classroom 103	980	70	30	22	yes	yes	yes	
Classroom 105	759	71	31	17	Yes	Yes	Yes	
Bygate	703	71	31	1	Yes	No	No	Window mounted a/c, door open
Classroom 106	850	72	28	20	Yes	Yes	Yes	
Classroom 128	824	72	29	20	Yes	Yes (3)		1 of 3 univents blocked by box, window mounted a/c

**Comfort Guidelines
tiles**

* ppm = parts per million parts of air
CEILING PANELS = water-damaged ceiling

Carbon Dioxide -	< 600 ppm = preferred 600 - 800 ppm = acceptable > 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results –Lynch Elementary School, Winchester, MA – March 15, 2001

Remarks	Carbon Dioxide *ppm (CO ₂)	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Classroom 110	631	70	29	14	Yes	Yes	Yes	Wall hole
Storeroom between Classrooms 110/100								Sugar, Black-Flag® ant & roach spray
Classroom 100	662	71	29	0	Yes	Yes	Yes	
Boys' Restroom						yes	yes	passive vent-missing
Room 16 – Mailroom	734	70	29	1	no	yes	no	photocopier, transparency maker, main frame, broken ceiling panels
Room 5 – Payroll	626	71	28	1	yes	yes (2)	no	2 window mounted air conditioners (a/c), photocopier, 3 water damaged ceiling panels, door open
Classroom 7	835	70	27	4	yes	yes	yes	2 window mounted a/c, 10+ water damaged ceiling panels, flowering plant on univent
Cafeteria	835	73	30	~120	yes	yes	yes	exhaust under stage, door open

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Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 3

Indoor Air Test Results –Lynch Elementary School, Winchester, MA – March 15, 2001

Remarks	Carbon Dioxide *ppm (CO ₂)	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Classroom 104	1168	72	30	20	yes	yes	yes	
Faculty Lounge	694	71	28	0	yes	no	no	
Room 15-Music	753	70	28	14	yes	yes (2)	yes	window mounted a/c
Classroom 125	548	68	29	4	yes	yes	yes	
Classroom 124	671	71	28	8	yes	yes	yes	Damaged window caulking
Classroom 115	666	70	28	0	yes	yes	yes	2 wall mounted local exhaust vents, door open, former home ec. room-2 sinks-shut off
Classroom 121	573	69	29	0	yes	yes	yes	air purifier
Classroom 120	699	70	29	12	yes	yes	yes	Cloth between – window caulk, - CT, door open
Classroom 119	780	68	28	18	yes	yes	yes	2 transparency makers, plants, exhaust vent behind door

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Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 4

Indoor Air Test Results –Lynch Elementary School, Winchester, MA – March 15, 2001

Remarks	Carbon Dioxide *ppm (CO ₂)	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Classroom 116	738	70	28	16	yes	yes	yes	Exhaust vent blocked by door-damaged louver, door open
Classroom 122	561	69	28	2	No	Yes	Yes	22 computers, door open
Classroom 123	825	70	29	11	Yes	Yes	Yes	Door open
Library	564	71	25	2	yes	yes (2)	yes	door open
Classroom 126	577	70	20	6	yes	yes	yes	door open, heat complaints
Superintendent's Office	635	71	28	2	Yes	Yes	Yes	Window mounted a/c, 4 water damaged CT, door open
Classroom 27		71	28	1	Yes	Yes	No	Window open, carpet, dehumidifier, window mounted a/c, reports of active leaks-wall/foundation
Classroom 28	776	73	29	11	Yes	Yes	Yes	Reports of water penetration-foundation, carpet
1 st Floor Hallway								Musty odors from crawlspace

**Comfort Guidelines
tiles**

* ppm = parts per million parts of air
CEILING PANELS = water-damaged ceiling

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 5

Indoor Air Test Results –Lynch Elementary School, Winchester, MA – March 15, 2001

Remarks	Carbon Dioxide *ppm (CO ₂)	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Occupational Therapy	606	73	27	4	Yes	Yes	Yes	
Hallway outside classroom 112								Active roof leak-bucket
Classroom 112	672	69	29	16	Yes	Yes	Yes	3 water damaged CT, exhaust fan, door open
Classroom 113	969	69	29	21	Yes	Yes	Yes	Door open
Classroom 114	501	69	27	0	Yes	Yes	Yes	Milk cartons

**Comfort Guidelines
tiles**

* ppm = parts per million parts of air
CEILING PANELS = water-damaged ceiling

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

Table 6

**Carbon Dioxide Air Monitoring Results Comparing April 27, 2000 and March 15, 2001
Lynch elementary School, Winchester , MA**

Area	Carbon Dioxide *ppm 4/27/00	Occupants in Room 4/27/00	Carbon Dioxide *ppm 3/15/01	Occupants in Room 3/15/01	Change after Repairs (+/-) *ppm	Comments
Outside (Background)	434		403			
Art Room		1	945	19		
Gym	604	18	759	0	+155	18 less occupants
Main Office			877	4		
Classroom 101	493	13	700	20	+207	7 less occupants
Classroom 102	1147	23				
Classroom 103	787	0	980	22	+193	22 more occupants
Classroom 105			759	17		
Bygate			703	1		
Classroom 106			850	20		
Classroom 128			824	20		
Classroom 110			631	14		
Classroom 100			662	0		

* ppm = parts per million parts of air

Table 7

**Carbon Dioxide Air Monitoring Results Comparing April 27, 2000 and March 15, 2001
Lynch elementary School, Winchester , MA**

Area	Carbon Dioxide *ppm 4/27/00	Occupants in Room 4/27/00	Carbon Dioxide *ppm 3/15/01	Occupants in Room 3/15/01	Change after Repairs (+/-) *ppm	Comments
Room 16 – Mailroom		0	734	1		
Classroom 7	528	3	835	4	+307	1 more occupant
Room 5 – Payroll	512	3	626	1	+114	2 less occupants
Cafeteria	770	100+	835	~120	+65	
Classroom 104	930	20	1168	20	+238	
Faculty Lounge	691	5	694	0	+3	5 less occupants
Room 15 – Music	641	25	753	14	+108	9 less occupants
Classroom 125	618	6	548	4	-70	2 less occupants
Classroom 124	639	7	671	8	+32	1 more occupant
Classroom 115	638	19	666	0	+28	19 less occupants
Classroom 121	595	17	573	0	-22	17 less occupants
Classroom 120	860	10	699	12	-161	2 more occupants
Classroom 119	1455	19	780	19	-675	Same occupancy

* ppm = parts per million parts of air

Table 8

**Carbon Dioxide Air Monitoring Results Comparing April 27, 2000 and March 15, 2001
Lynch elementary School, Winchester , MA**

Area	Carbon Dioxide *ppm 4/27/00	Occupants in Room 4/27/00	Carbon Dioxide *ppm 3/15/01	Occupants in Room 3/15/01	Change after Repairs (+/-) *ppm	Comments
Classroom 116	1200	21	738	16	-462	5 less occupants
Classroom 122	609	1	561	2	-48	1 more occupant
Classroom 123			825	11		
Library	568	0	564	2	-4	2 more occupants
Classroom 126	559	5	577	6	+18	1 more occupant
Superintendent's Office			635	2		
Classroom 27						
Classroom 28			776	11		
Occupational Therapy			606	4		
Classroom 112			672	16		
Classroom 113			969	21		
Classroom 114			501	0		

* ppm = parts per million parts of air